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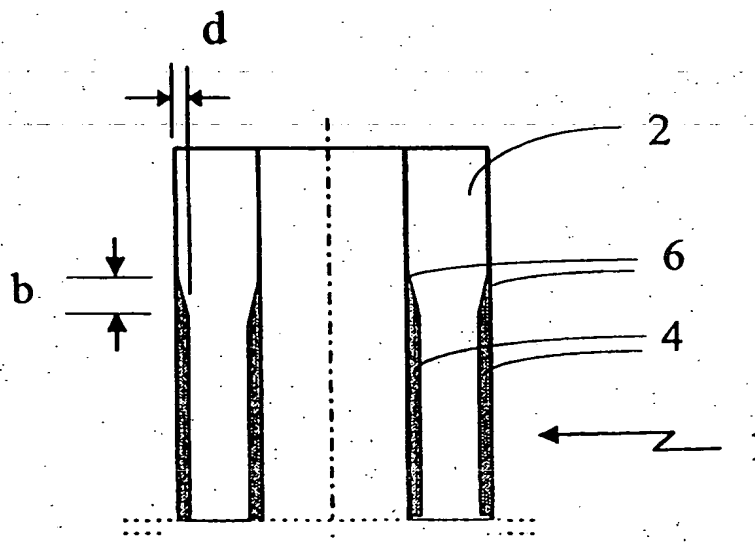
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>C23C 8/04, E21B 17/00</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 99/13125</b> <b>(43) International Publication Date:</b> 18 March 1999 (18.03.99)
<b>(21) International Application Number:</b> PCT/SE98/01525 <b>(22) International Filing Date:</b> 26 August 1998 (26.08.98)  <b>(30) Priority Data:</b> 9703262-7      10 September 1997 (10.09.97)      SE  <b>(71) Applicant:</b> SANDVIK AB [SE/SE]; S-811 81 Sandviken (SE). <b>(72) Inventor:</b> LUNDELL, Lars-Gunnar; Urangatan 13, S-811 52 Sandviken (SE).  <b>(74) Agent:</b> CARLSSON, Lars-Åke; Sandvik AB, Patent Dept., S-811 81 Sandviken (SE).		<b>(81) Designated States:</b> AU, BR, CA, CN, JP, MX, PL, RU, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** A DEVICE, A DRILL MEMBER AND A METHOD FOR MASKING THE MEMBER AT THERMO CHEMICAL SURFACE TREATMENT

**(57) Abstract**

The present invention relates to a device, a drill member and a method for masking the member at thermo chemical surface treatment. The drill member (1) such as a drill tube or a drill rod, has a substantially elongated basic shape and at least one free end (2) as well as a central channel for flush medium. Hardened portions (4) with a first case depth (d) are provided at least partly at the jacket surface of the member. Not hardened portions are provided at least partly at said free end (2), wherein a transition zone (6) in the longitudinal direction between hardened and not hardened material have a first length (b). The first length (b) of the transition zone (6) is longer than the first case depth (d).



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**A device, a drill member and a method for masking the member at thermo chemical surface treatment**

The field of the invention

5                   The present invention relates to a device, a drill member and a method for masking the member at thermo chemical surface treatment according to the preambles of respective independent claims.

Technical background

10                   At thermo chemical surface treatment such as carburizing, nitrocarburization, boriding etc. is sometimes required that certain surfaces shall maintain the same chemical composition as before the heat treatment. Normally, this happens by covering these surfaces with some preparation which prevents the steel surface from being directly exposed to the furnace atmosphere. The coating  
15                   forms a more or less diffusion sealed layer for elements in the furnace atmosphere which is not in equilibrium with steel. The coating can be done in a number of ways such as by brushing, dipping, spraying of fluid coating, sticking of pastes or by electrolytic copper coating. At for example carburizing of tubes one wishes that the ends and about 20 mm along the tube are not carburized, neither internally  
20                   nor externally, a usual method is to dip the tube end in color which then may dry under increased temperature. For the layer to be dense drops must not be formed and the layer must not be too thin. Therefore often an adjustment must be done with a brush or with another tool after the dipping for smoothing the layer. The method is expensive since it requires large exactness both with regards to color  
25                   (viscosity, composition etc.) and the applying. Fig. 1 shows an example of a drill member or a tube 1 which has been covered with a protective coating in a conventional manner through dipping of the end 2. The protective coating is applied at the end surface and along a part of the surface of the tube and somewhat down at the inside according to markings in Fig. 1. Arrows depict the  
30                   motion of the furnace atmosphere on the surfaces. Fig. 3 shows an example of a carburized tube 1 which has been painted at the end surface 2 before carburizing.

- The carburized layer which has a depth often about 1 mm obtains a relatively abrupt transition 5 where the painted surface starts. The transition zone length is marked by the letter a, often about 1 mm. The abruptness of the transition 5 can be calculated by dividing the transition zone length with the depth, i.e.  $a/d$ .
- 5 Thereby the abruptness amounts to about 1 at the conventional method for heat-treatment such as disclosed in for example US-A-4,165,243. The abrupt transition provides unfavorable states of strain in the surface for example if the tube or the rod is submitted to bending or impact stresses. A thermo chemical treatment of a down-the-hole drill bit is described in US-A-4,867,015, wherein the insert holes in
- 10 the drill bit are covered with paint before the heat-treatment is started.

#### Objects of the invention

- One object of the present invention is to provide a method for masking a member at thermo chemical surface treatment in a simple and thereby
- 15 cost-effective manner.

Another object of the present invention is to provide a method for masking a member at thermo chemical surface treatment for improving the strength of the member.

- Still another object of the present invention is to provide a drill
- 20 member with successively varying case depth.

Still another object of the present invention is to provide a device which enables control of the case depth.

#### Description of the figures

- 25 Fig. 1 shows an example, in a perspective view, of a drill member covered with protective coating in a conventional manner through dipping. Fig. 2 shows a device according to the present invention in a sectioned side view. Fig. 3 shows an example of a drill member, in cross section, after conventional painting at one end and carburizing. Fig. 4 shows an example of a drill member according
- 30 to the present invention, in cross-section, after carburizing. Fig. 5 shows an alternative embodiment of a device according to the present invention in a

sectioned side view. Fig. 6 shows an example of an alternative embodiment of a drill member according to the present invention, in cross-section, after carburizing.

#### Detailed description of the invention

5 Fig. 2 shows a device or a lid 3, of for example ceramics or steel, for counteracting thermo chemical effect of a steel surface 14. The steel surface is preferably provided on a tube- or rod end 2 to be used for percussive drilling. The device has a rotation symmetrical tubular outer wall or external lid part 11 and a rotation symmetrical tubular internal wall or inner lid part 12. The inner and  
10 external walls 12, 11 are connected by a ring-shaped wall portion 13 at one end surface such that a circular recess 15 is formed for receiving of a tube 1 end. The internal diameter of the outer wall 11 and the outer diameter of the internal wall 12 shall be dimensioned such that the gap opening 7 relative to the tube 1 which is to be protected against thermo chemical treatment does not become larger than  
15 0,1 mm. The lid is mounted at the tube 1 end 2 during the heat-treatment. Arrows depict the motion of the furnace atmosphere about the surfaces.

Fig. 4 shows an example of a carburized tube 1 which has been protected against carburizing at the tube end (externally and internally) by the aid of a lid according to the present invention. The lid covers both the end surface 14  
20 and the connecting part of the envelope surface. The carburized layer has an elongated and continuous transition zone 6 between the carburized layer and the untreated end surface 2. The transition zone length is depicted by the letter  $\underline{b}$ . The transition zone length  $\underline{b}$  of the thermo chemically treated surface is longer, preferably more than double the case depth  $\underline{d}$ , than the transition zone length  
25 which is obtained at other protective methods such as dipping, painting, etc. The external lid part 11 and the internal lid part 12 have the same length and thereby gives just as long protected area at the inside and outside surfaces, respectively, of the tube 1. By the expression "not carburized" and similar expressions, is here  
30 substantially does not influence the result of the heat treatment.

Fig. 5 shows an alternative embodiment of a device or lid 3' according to the present invention. The device 3' has chamfered exits 7' both externally and internally, wherein the transition between the carburized layer 4' of the carburized part of the tube 1' and the not carburized surface of the tube end 2' becomes longer. This is shown in Fig. 6 where the transition zone length is depicted by the letter  $c$ . The length of the transition zone can be adjusted by more or less chamfering of the internal diameter of the external lid part and likewise chamfering of the outer diameter of the internal wall of the device 3'.

At comparison of the three different variants described above the following relationship of the transition zone lengths for the carburizing layers applies  $a < b < c$ .

The protective lid 3 is developed to fit into a rotation symmetrical tube- or rod end. The object is that the lid shall have sufficient fit such that the furnace atmosphere will not enter too far along the part of the tube wall which is protected against thermo chemical treatment such as for example carburizing. Normally, it is sufficient with a gap of  $\leq 0,1$  mm if there simultaneously is abutment between the end surface of the tube end and the bottom of the lid.

By chamfering the lid, such as is shown in Figure 5, with chamfers 7' the gap opening is increased. Thereby the transition zone 6' for example for the carburizing layer can be made even longer, with length  $c$ , than with a gap opening with a constant width. In this manner favorable tensions in the transition are obtained for example when the tube or rod is submitted to bending stresses.

Alternatively the external lid part 11 and the internal lid part 12 have different lengths and thereby give differently extended protected areas at the internal and external surfaces of the tube 1. Likewise the internal diameter at 10 of the inner lid part can be reduced such that the thermo chemical effect at the inside of the tube 1 becomes less than at the tube surface.

The lid must be made of a material which do not influence the composition in the tube surface. Preferably a ceramic material or a steel is used which has a composition which is balanced with respect to the steel in the tube.



The lid is placed either on top of the standing tube ends such that the lid falls down by its own weight against the tube end surface or the tube can be positioned on the lid. The hole through the lid entails that the thermo chemical treatment is also obtained at the inside of the tube on the surfaces which internally is not protected by the lid. By making a small hole in the lid the carburizing depth inside on the unprotected surfaces can be made less than at the external unprotected surfaces.

The method relates to applying a lid on the part of the tube which is not to be thermo chemically treated. The method for masking a drill member at thermo chemical surface treatment, such as carburizing or nitriding comprises the following steps: providing a drill member such as a drill tube or a drill rod, said member having a substantially elongated basic shape and at least one free end and a central channel for flush medium, providing a lid which is substantially geometrically adapted to the free end of the member, bring the lid and the free end of the member to abutment against each other, place the lid and the member in a furnace having a suitable furnace atmosphere and a suitable temperature for heat-treatment of metal, allow the furnace atmosphere to partly enter in between the lid and the member such that the heat-treatment is successively reduced in direction towards the free end surface and such that the transition zone becomes elongated, and cool the lid and the member to ambient temperature and remove the lid from the member. Then the drill member is adapted to be friction welded to a threaded part or a drill bit for percussive drilling.

There are several advantages with this method, such as quick applying and removal of the protection, good reproducibility of the protective effect, possibility to vary the transition between the thermo chemically treated surface and the untreated surface, possibility to vary the thermo chemical treatment at the inside of the tube and possibility to control the length and the appearance of the transition.

Claims

1. Method for masking a drill member at thermo chemical surface treatment, such as carburizing or nitriding, said method comprising the following steps:
- 5   - providing a drill member (1;1') for percussive drilling, such as a drill tube or a drill rod, said member having a substantially elongated basic shape and at least one free end (2;2') and a central channel for flush medium,
- providing a lid (3;3') which is substantially geometrically adapted to the free end (2;2') of the member,
- 10   - bringing the lid and the free end of the member (2;2') to abutment against each other,
- placing the lid and the member in a furnace having suitable furnace atmosphere and suitable temperature for heat-treatment of metal,
- allowing the furnace atmosphere to partly enter in between the lid and the
- 15   member such that the heat-treatment is successively reduced in direction towards the free end surface (2;2') and such that the transition zone becomes elongated,
- cooling the lid and the member to ambient temperature and
- removing the lid from the member.
- 20   2. Method according to claim 1,
- c h a r a c t e r i z e d i n that the following further step is made:
- friction welding the member to a threaded part or a drill bit.
3. Drill member for percussive drilling such as a drill tube or a drill rod
- 25   manufactured according to the method described in claim 1, said member (1;1') having a substantially elongated basic form and at least one free end (2;2') and a central channel for flush medium, wherein hardened portions (4) with a first case depth (d) are provided at least partly on the jacket surface of the member, wherein not hardened portions are provided at least partly at said free end (2;2'), wherein a
- 30   transition zone (6;6') in the longitudinal direction between hardened and not hardened material have a first length (b,c),

characterized in that the first length (b,c) of the transition zone (6;6') is longer than the first case depth (d).

4. Drill member according to claim 3,

5 characterized in that the first length (b,c) of the transition zone (6;6') is at least double as the first case depth (d).

5. Drill member according to claim 3 or 4,

characterized in that it is tube- or rod-shaped.

10

6. Drill member according to claim 3, 4 or 5,

characterized in that the free end surface is connected to a threaded part or a drill bit by a friction weld.

15 7. Device for protecting metal surfaces from thermo chemical effect, said device (3;3') being intended to be provided at an end of an elongated drill member for percussive drilling,

characterized in that the device (3;3') comprises a recess (15) which is bordered by at least one radially external wall (11) dimensioned in relation to the  
20 drill member such that in use it allows furnace atmosphere to partly enter in between the recess (15) and the member such to create an elongated transition zone in the drill member.

8. Device according to claim 7,

25 characterized in that the device (3;3') comprises a central hole (10) and a radially inner wall (12).

9. Device according to claim 7 or 8,

characterized in that the radially external wall (11) and/or the radially  
30 inner wall (12) comprises chamfered portions (7').

10. Device according to claim 7, 8 or 9,  
c h a r a c t e r i z e d i n that the device (3;3') is rotation symmetrical and forms a  
tubular outer wall and a rotation symmetrical tubular internal wall, which are  
connected by a ring-shaped wall portion (13) at one end surface.

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Fig. 1 (PRIOR ART)

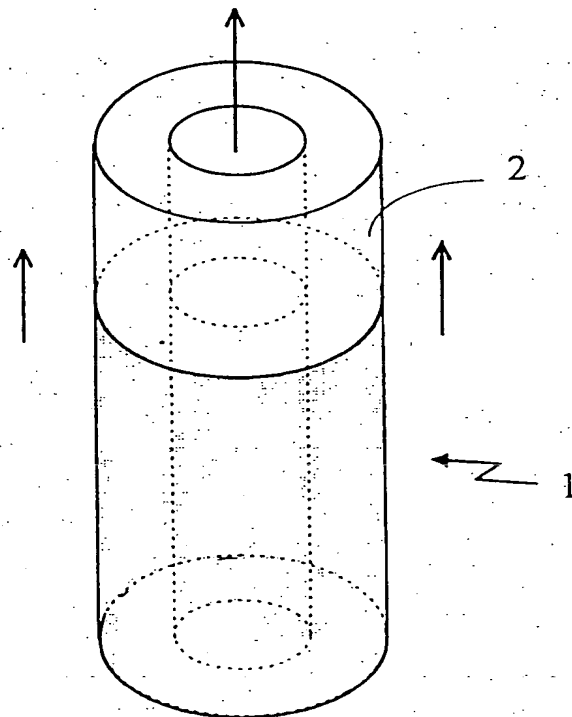
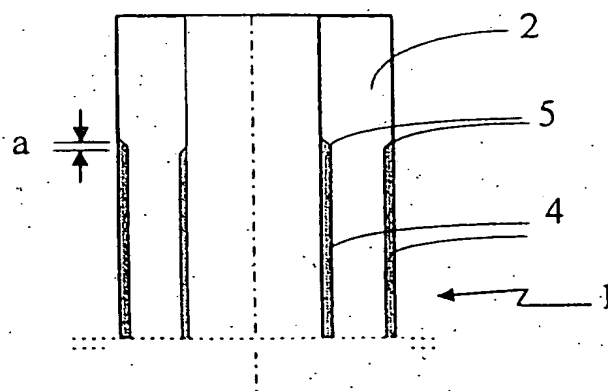
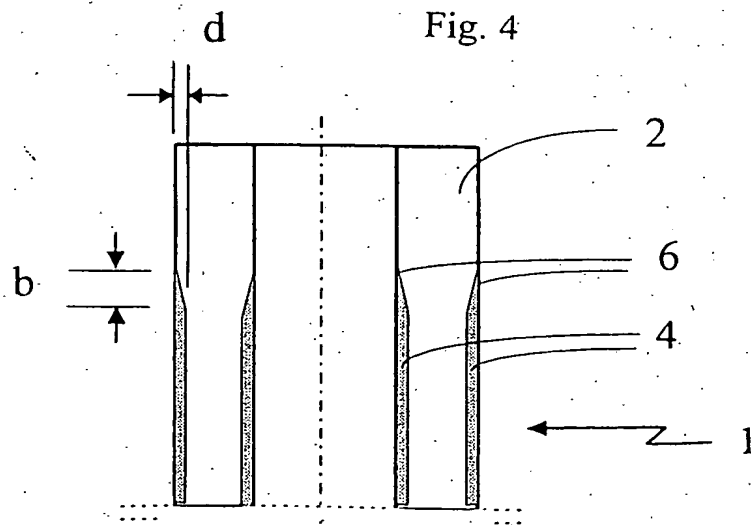
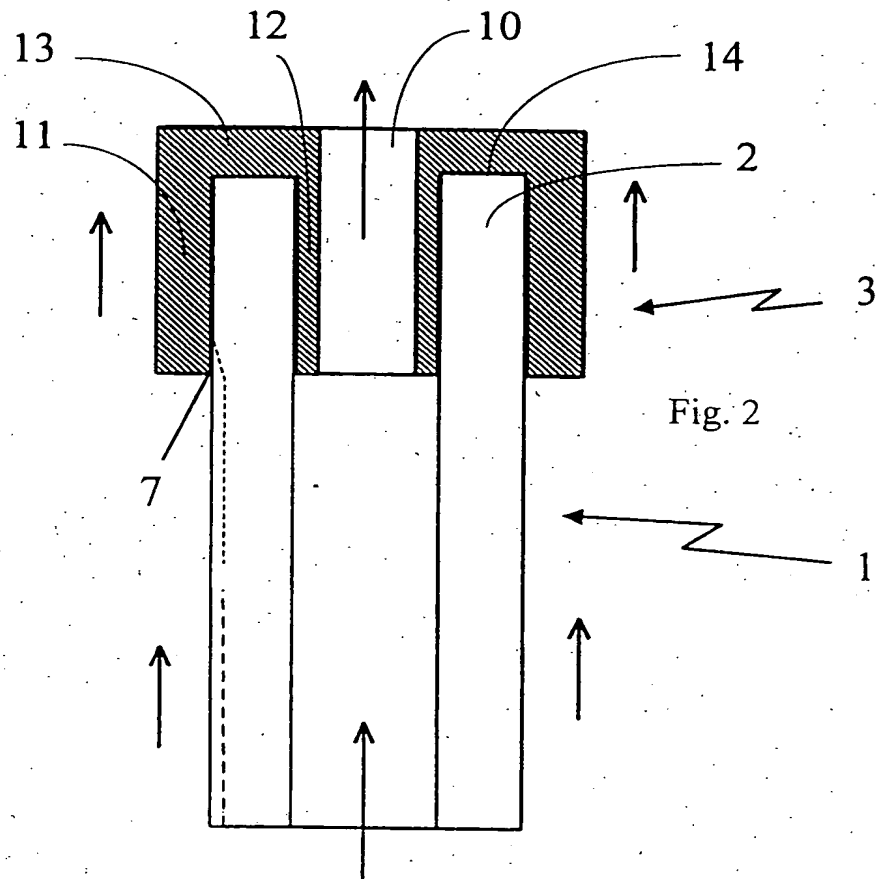


Fig. 3 (PRIOR ART)



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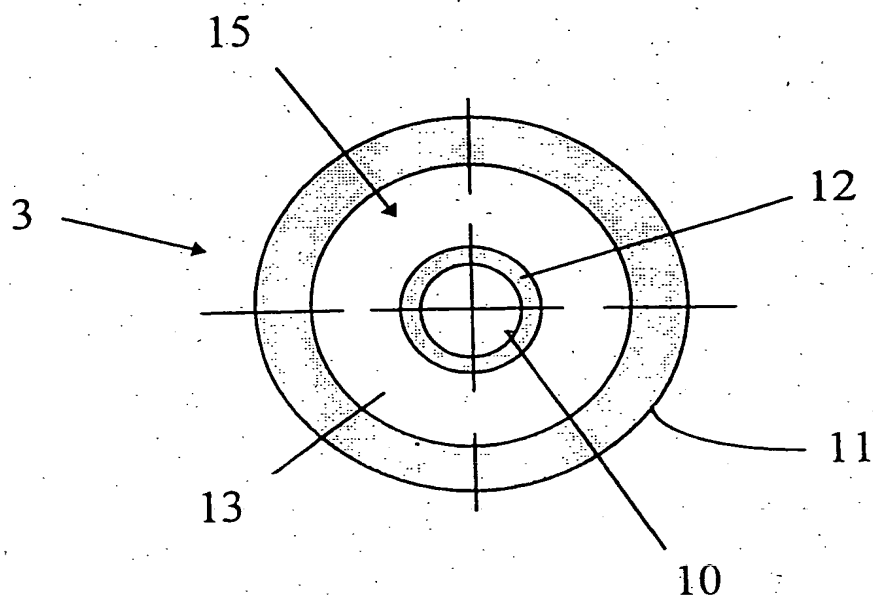


Fig. 2 B

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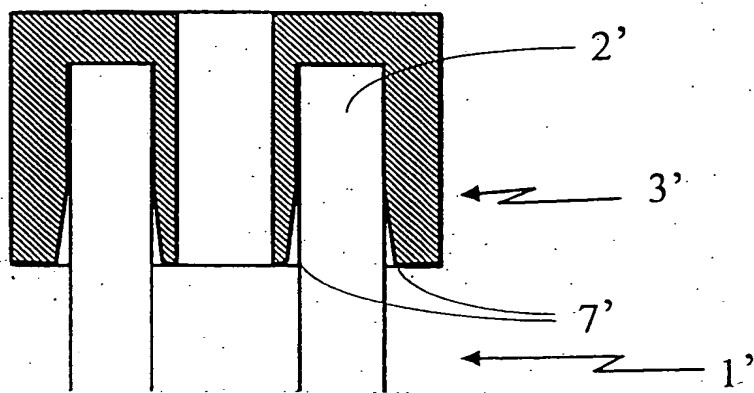


Fig. 5

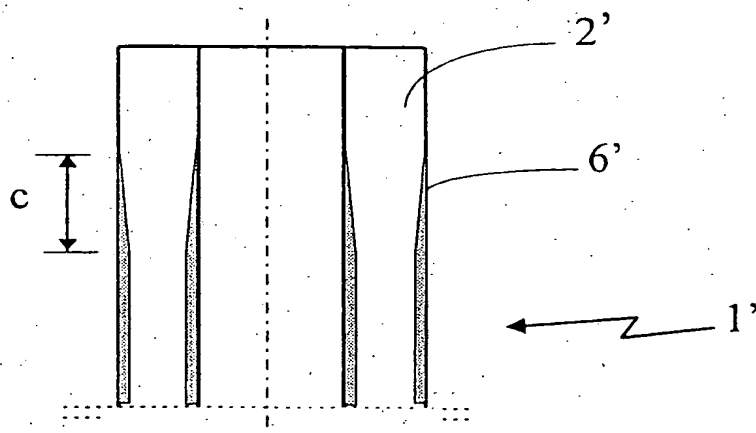


Fig. 6



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/01525

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C23C 8/04, E21B 17/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

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IPC6: C23C, C21D, E21B

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WPI, EDOC, JAPIO

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4165243 A (MYRON C. SARNES ET AL), 21 August 1979 (21.08.79), column 4, line 28 - line 38; column 6, line 38 - column 10, line 16, figures 5,6 --	1-10
A	WO 9727022 A1 (SANDVIK AB (PUBL)), 31 July 1997 (31.07.97), page 4, line 24 - page 5, line 8, claims 3,4, abstract --	2,6
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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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